CONTRIBUTIONS

FROM THE

CUSHMAN LABORATORY

FOR

FORAMINIFERAL RESEARCH

VOLUME 15, PART 2

JUNE, 1939

CONTENTS

SHARON, MASSACHUSETTS, U. S. A.

1939

CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

Brook Road, Sharon, Mass., U. S. A.

JOSEPH A. CUSHMAN, Sc.D., Director
ALICE E. CUSHMAN, Secretary, in charge of Publications
FRANCES L. PARKER, M.S., Research Assistant
PATRICIA G EDWARDS, A. B., Research Assistant
ANN SHEPARD, Illustrator

These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

Subscription $2.50 per year post paid.

Volume 1, April 1925—January 1926 (Reprinted, 1935) $3.00
Volume 2, April 1926—January 1927 (Reprinted, 1935) $3.00
(Volume 3, part 1 now out of print.)
Volume 3, parts 2-4, June—December, 1927 (Reprinted, 1936) . $2.00
Volume 4, parts 1-4, March—December, 1928, complete $2.50
Volume 5, parts 1-4, March—December, 1929, complete $2.50
Index to Volumes 1—5 inclusive $1.00

Volume 6, parts 1-4, March—December, 1930, complete $2.50
Volume 7, parts 1-4, March—December, 1931, complete $2.50
Volume 8, parts 1-4, March—December, 1932, complete $2.50
Volume 9, parts 1-4, March—December, 1933, complete $2.50
Volume 10, parts 1-4, March—December, 1934, complete $2.50
Index to Volumes 6-10 inclusive $1.00

Volume 11, parts 1-4, March—December, 1935, complete $2.50
Volume 12, parts 1-4, March—December, 1936, complete $2.50
Volume 13, parts 1-4, March—December, 1937, complete $2.50
Volume 14, parts 1-4, March—December, 1938, complete $2.50
Volume 15 subscription, 1939 ..... $2.50

Special Publications:

No. 1. Foraminifera, Their Classification and Economic Use. 1928 $5.00
No. 2. A Resumé of New Genera of the Foraminifera Erected Since Early 1928. 1930 ..... .50
No. 3. A Bibliography of American Foraminifera. 1932 ..... 1.10
No. 4. Foraminifera, Their Classification and Economic Use, Ed. 2. 1933.
No. 5. An Illustrated Key to the Genera of the Foraminifera. 1933. (No. 5 alone $2.00; foreign $2.50. Nos. 4 and 5 together, $5.00; foreign $6.00. No. 4 not sold separately.)
No. 6. New Genera and Species of the Families Verneuilinidae and Valvulinidae and of the Subfamily Virgulininae. 1936 ..... 1.50

For continuation of this series, see back cover page.

Copies of Volume 15, part 2 were first mailed JUNE 1, 1939

PRESS OF M. A. JOHNSTON, BRIDGEWATER, MASSASCHUSETTS, U. S. A.

CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

---

205. RUPERTIA (?) ADAMSI, A NEW SPECIES FROM THE PLIOCENE OF CALIFORNIA

By JOSEPH A. CUSHMAN

The relationships of the family Rupertiidae are known to be close to the Anomalinidae, particularly through the genus *Cibicides*. The species described below shows the intermediate stages between *Cibicides* and *Rupertia* in a remarkable degree.

From *Cibicides* are developed numerous genera such as *Dyocibicides*, in which, after the early attached *Cibicides* stage, the adult development is biserial; *Rectocibicides*, in which, following the *Cibicides* stage, is developed a uniserial stage in the adult; *Cibicidella*, with a very irregular development of chambers at one side; *Annulocibicides* and *Cyclocibicides*, in which, following the early *Cibicides* stage, the adult chambers are elongate about the periphery, and tend to become annular. All of these are forms developed almost entirely in one plane, and are probably attached throughout most of their life cycle.

On the other hand, there are forms such as *Anomalina semipunctata* (Bailey), often referred to the later name, *A. polymorpha* Costa, which have a different development. The test develops an elongate axis which on the ventral side becomes deeply concave, and the ends tend to become elongated into spinose projections. The records for this species include the Mediterranean Area, the Atlantic, and parts of the Pacific. It also occurs in the late Tertiary of some of these regions. As usual, a number of the figured specimens referred to this species are not identical.

The peculiar form found in the late Tertiary of California is very interesting, as it carries this development further, and very

definitely connects the development of *Cibicides* with that of *Rupertia*, a relationship already recorded. A description follows:

RUPERTIA (?) ADAMSI Cushman, n. sp. (Pl. 5, figs. 1-11)

Test in the early stages similar to *Cibicides*, trochoid, biconvex, the aperture near the periphery and extending to the dorsal side, with a distinct lip, and the periphery slightly keeled; test becoming elongate as development progresses, the chambers tending to overlap the earlier whorls, and to extend out into blunt, spinose processes, in later development forming in an irregular whorl about a large opening with a smooth surface; sutures limbate; wall coarsely perforate but smooth. Length in the adult up to 1.35 mm.; diameter up to 0.75 mm.

Holotype (Cushman Coll. No. 25640) from the late Tertiary, core sample at 1,219 ft., General Petroleum's Terminal No. 1 Well, located 468 feet southwesterly from westerly line of Ford St. (measured along Los Angeles-Long Beach boundary), thence northwesterly 90° 150 feet, in section 4, Township 5 South, Range 13 West, San Bernadino Base and Meridian, Wilmington, California.

This species is related to *Rupertia stabilis* Wallich, but has a less definitely spiral adult and an open instead of solid base. It is named for Mr. Bradford C. Adams.

The adults of this form are very variable in shape, and do not have the elongate spiral form of *R. stabilis*.

The smooth appearance of the thickened part around the large open area without perforations suggests that this portion may have been attached. In *Rupertia* however, the attachment is by the dorsal side, while in our species the dorsal side, while not usually covered, is ordinarily somewhat convex and shows no sign of having been attached.

This species therefore, while it shows certain characters tending toward *Rupertia*, may represent a distinct genus, but a study of additional material, and possibly other species, would be necessary to determine this. It may be that this is a free species, and that the large open area may represent the apertural characters seen in some specimens of *R. stabilis*. Recently, a fine series of *R. stabilis* has been available for study from cores from the Eastern Atlantic, and these have shown that some of the records for the species are probably not identical. This seems particularly true of the specimens figured by Uhlig from the

"Alttertiar" of West Galicia (Jahrb. k. k. geol. Reichsanst., vol. 36, pt. 1, 1886, p. 184, pl. 4, figs. 1, 2). These may be the same as "*Rupertia incrassata* Uhlig" (l. c., figs. 3-9) from the same locality. The form referred to as "*Rupertia* (?) *floridana* Cushman" from the Eocene of Florida needs further material to give its relationships more clearly.

Unfortunately the records for *R. stabilis* are usually not accompanied by figures. The records include the Arctic off Spitzbergen and Greenland, both sides of the Atlantic and the Gulf of Mexico, off West Africa, Mauritius, the Falklands, off Australia and the Eastern Pacific. The figures given however seem to indicate that more than one species may be represented. Besides the reference of Uhlig given above, *R. stabilis* has been recorded as a late Tertiary fossil from the Bismarck Archipelago by Schubert, from the Miocene of Somalia by Silvestri, and from the Pleistocene of California by Galloway and Wissler. The latter is accompanied by a figure, but evidently represents a young stage. There is a possibility that it may represent *R.* (?) *adamsi.*

It will be interesting to see what additional material may show as to the relationships of our species with typical *Rupertia.*

206. SOME NEW AND INTERESTING FORAMINIFERA FROM THE KREYENHAGEN SHALE OF CALIFORNIA*

By JOSEPH A. CUSHMAN and STANLEY S. SIEGFUS

In a previous paper in these Contributions (vol. 11, pt. 4, Dec., 1935) some notes on the Garza Creek exposures were given and a number of new species described. Since the publication of that paper further study has brought to light a number of other new species, and some which have been already described from other areas, that rather definitely correlate the fauna of Garza Creek with Eocene formations elsewhere. The lower part of the section contains certain species known only from the Eocene, Aragon

* Published by permission of the Director of the United States Geological Survey.

formation, of Mexico. In the beds above are species known from the Guayabal formation of Mexico and the Claiborne of the Gulf Coastal Plain region of the United States. The upper part of the section has species which are identical with those known from the Chapapote of Mexico which is considered to be of Upper Eocene or Jackson age. The new species are here described and figured, and a few of the other species are also figured.

DOROTHIA PRINCIPENSIS Cushman and Bermudez (Pl. 6, fig. 23)

Dorothia principensis CUSHMAN and BERMUDEZ, Contr. Cushman Lab. Foram. Res., vol. 12, 1936, p. 57, pl. 10, figs. 3, 4.—CUSHMAN, l. c., Special Publ. No. 8, 1937, p. 87, pl. 9, figs. 20, 21.

This species was originally described from the Eocene, lower Principe formation of Cuba. It is one of the species which connects this Garza Creek Eocene with that of Cuba.

MARGINULINA ASPERULIFORMIS (Nuttall) (Pl. 6, figs. 1-3)

Cristellaria asperuliformis NUTTALL, Journ. Pal., vol. 4, 1930, p. 282, pl. 23, figs. 9, 10.

Marginulina asperuliformis BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 12, 1938, p. 15.

"Test with earlier portion close-coiled, later portion uncoiled, compressed, especially in the earlier portion. Chambers distinct, separated by elevated limbate sutures, which bear fine tubercles

---

EXPLANATION OF PLATE 5

All figures × 65

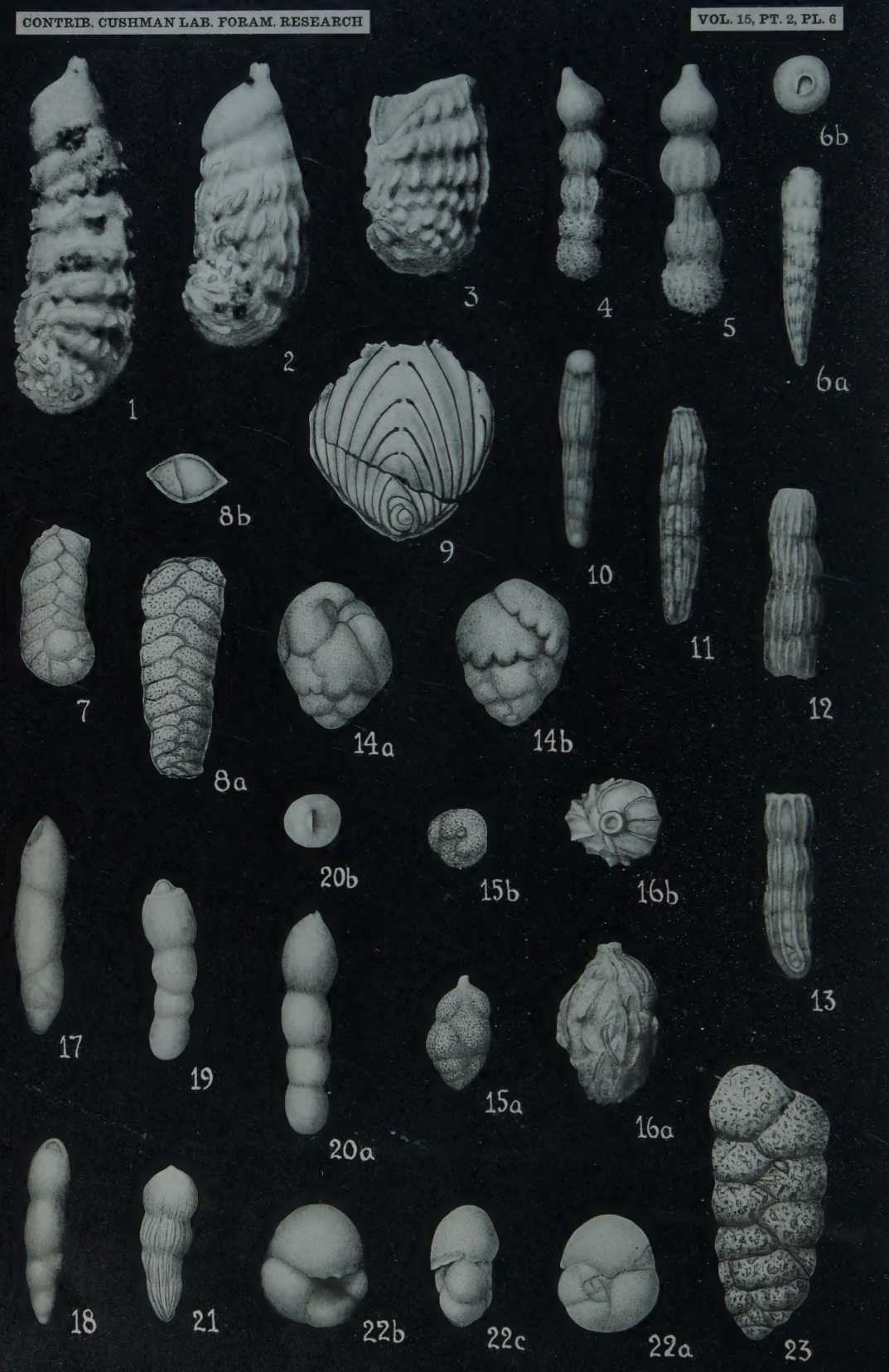
Rupertia (?) *adamsi* Cushman, n. sp.

FIGS.

1–3. Early stages with *Cibicides* characters before the later development.
4, 5. Specimens tending to become elongate and cover the earlier whorls.
6, 7. Specimens covering more of the earlier stages, and developing spinose projections.
8. Holotype. Showing the elongate form with spinose projections at either end of the elongate axis.
9. Specimen showing the enlarged hollow area with smooth enclosing surface.
10. Very irregular specimen with extensions at each end of the elongate axis.
11. Very large specimen largely covering the early stages.

From photographs retouched by Patricia G. Edwards.


1
2
3
4
5
6
7
8
9
10
11


1
2
3
4
5
6b
6a
8b
9
10
11
12
7
8a
14a
14b
20b
15b
16b
13
17
19
20a
15a
16a
18
21
22b
22c
22a
23

that are variable in number and become less pronounced or absent in the last chambers. Aperture radial, terminal. Periphery sharp, in most specimens with a thin narrow keel. Average length 1.5 mm."

This species was described by Nuttall from the Eocene, Aragon formation, of Mexico. He notes that it is practically confined to this formation. It is of interest to compare our specimens with Nuttall's types and to find that they are apparently the same species. There is considerable variation but our specimens show about the same range of variation as do his. This would seem to be a good marker for correlating the lower part of the Kreyenhagen with the Aragon of Mexico.

It is recorded also by Dr. Bermudez from the Jabaco formation of Cuba in company with other species from the Aragon.

DENTALINA HISPIDO-COSTATA Cushman and Siegfus, n. sp. (Pl. 6, figs. 4, 5)

Test elongate, uniserial, of nearly uniform diameter through-

---

EXPLANATION OF PLATE 6

FIGS.

1–3. *Marginulina asperuliformis* (Nuttall). × 38.

4, 5. *Dentalina hispido-costata* Cushman and Siegfus, n. sp. × 25. 4, Holotype. 5, Paratype.

6 *a, b*. *Bifarina nuttalli* Cushman and Siegfus, n. sp. × 30. Holotype. *a*, front view; *b*, apertural view.

7, 8. *Spiroplectoides directa* Cushman and Siegfus, n. sp. × 55. 7, Holotype. 8, Paratype. *a*, front view; *b*, apertural view.

9. *Plectofrondicularia garzaensis* Cushman and Siegfus, n. sp. × 50. Holotype.

10–13. *Amphimorphina ignota* Cushman and Siegfus, n. sp. × 25. 11, Holotype. 10, 12, 13, Paratypes.

14 *a, b*. *Buliminella grata* Parker and Bermudez. × 55. *a*, front view; *b*, rear view.

15 *a, b*. *Uvigerina garzaensis* Cushman and Siegfus, n. sp. × 38. Holotype.

16 *a, b*. *Uvigerina churchi* Cushman and Siegfus, n. sp. × 45. Holotype. *a*, front view; *b*, apertural view.

17, 18. *Pleurostomella nuttalli* Cushman and Siegfus, n. sp. × 45. 18, Holotype. *a*, side view; *b*, apertural view. 17, Paratype.

19, 20. *Nodosarella advena* Cushman and Siegfus, n. sp. × 38. 20, Holotype. *a*, front view; *b*, apertural view. 19, Paratype.

21. *Nodosarella ignota* Cushman and Siegfus, n. sp. × 38. Holotype.

22 *a–c*. *Valvulineria advena* Cushman and Siegfus, n. sp. × 38. Holotype. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

23. *Dorothia principensis* Cushman and Bermudez. × 55.

From drawings and retouched photographs by Patricia G. Edwards.

out; chambers subglobular, of almost equal size, proloculum as large as the succeeding chambers, earlier ones much overlapping, later ones with distinct contractions over the sutures and more separated; sutures distinct, slightly depressed in the earliest portion, gradually more so as chambers are added; wall of the proloculum hispid or finely spinose, becoming definitely longitudinally costate in the following chambers, last-formed ones smooth; aperture radiate, with a slight tapering neck, eccentric. Length up to 1.30 mm.; diameter 0.20-0.30 mm.

Holotype (Cushman Coll. No. 25434) from the Eocene, Kreyenhagen shale, Oil Canyon, 30 feet above upper sand, near W. ¼ corner, Sec. 16-19-15, California.

This species somewhat resembles *D. halkyardi* Cushman but differs in the parallel sides and the reverse development of the ornamentation which in *D. halkyardi* starts with longitudinal costae and becomes spinose while our species starts with a spinose proloculum and becomes costate.

SPIROPLECTOIDES DIRECTA Cushman and Siegfus, n. sp. (Pl. 6, figs. 7, 8)

Test elongate, about three times as long as wide, strongly compressed, periphery acute or slightly keeled, sides nearly parallel, initial end broadly rounded; chambers in the early stages planispiral, later biserial, low and broad in the adult of rather uniform size and shape; sutures distinct, nearly flush with the surface, slightly limbate, curved near the inner end thence nearly straight and gently sloping to the periphery where they merge with the slight keel; wall calcareous, fairly thin, coarsely perforate; aperture elongate, terminal. Length 0.60-0.75 mm.; diameter 0.20 mm.

Holotype (Cushman Coll. No. 25445) from Kreyenhagen shale, Upper Garza Creek, California, 104 feet below top of Kreyenhagen.

This species differs from *S. curta* Cushman in the more reduced spiral portion, greater compression of the test and the larger number of chambers which are also much lower and broader.

PLECTOFRONDICULARIA GARZAENSIS Cushman and Siegfus, n. sp. (Pl. 6, fig. 9)

Test oval or broadly elliptical in front view, very strongly compressed, sides flattened, periphery with a narrow thin keel except toward the apertural end; chambers numerous, only the very earliest ones showing the biserial arrangement, later ones chevron-shaped, increasing rather rapidly but regularly in size and

height as added; sutures very distinct, gently curved, slightly limbate, very slightly if at all depressed; wall smooth, very finely perforate. Length 0.75-1.00 mm.; breadth 0.60-0.70 mm.

Holotype (Cushman Coll. No. 25448) from Kreyenhagen shale, Garza Creek, California.

This species differs from *P. vaughani* Cushman which it most closely resembles in the more broadly elliptical form, more rounded initial end, more definite keel and fewer biserial chambers.

AMPHIMORPHINA IGNOTA Cushman and Siegfus, n. sp. (Pl. 6, figs. 10-13)

Test with the very earliest portion biserial, the rest of the test uniserial, compressed throughout, the earlier portions strongly so, last-formed chambers in the adult only slightly compressed, early portion with the periphery keeled, in the last chambers in the adult rounded, initial end rounded, apertural end truncate; chambers in the early portion obscured by the ornamentation, not inflated, later ones in the adult slightly inflated and the sutures distinct and slightly depressed; wall ornamented with distinct plate-like longitudinal costae, few in number in the earliest portion, increasing in number and less in height in the adult; aperture broadly elliptical in the adult, terminal without a distinct lip. Length up to 2.30 mm.; diameter 0.22-0.35 mm.

Holotype (Cushman Coll. No. 25450) from the Eocene, Kreyenhagen shale, from Oil Canyon, 30 feet above upper sand, W. ¼ corner, Sec. 16-19-15, California.

This is a unique species differing from *A. crassa* Cushman and Bermudez from the Eocene of Cuba in the more tapering, compressed test, the increasing number of costae and less development in the later portion. Our species somewhat resembles that from the Eocene of Venezuela referred by Nuttall to "*Plectofrondicularia mexicana* (Cushman)" but is not the same as that species.

BULIMINELLA GRATA Parker and Bermudez (Pl. 6, figs. 14 a, b)

Buliminella grata PARKER and BERMUDEZ, Journ. Pal., vol. 11, 1937, p. 515, pl. 59, figs. 6 *a-c*.—BERMUDEZ, Mem. Soc. Cubana Hist. Nat., vol. 11, 1937, p. 342.

Our figured specimens are from the Kreyenhagen shale of Little Tar Canyon. These specimens have been compared with the types from the Eocene of Cuba and are identical. This species

occurs in the Eocene of Bermudez's Jabaco formation in company with *Marginulina asperuliformis* (Nuttall), *Cibicides cushmani* Nuttall and other species described by Nuttall from the Aragon formation of Mexico. This is a very distinctive species and not to be confused with any other described one so makes an excellent index fossil for correlation of this portion of the Kreyenhagen with other areas.

BIFARINA NUTTALLI Cushman and Siegfus, n. sp. (Pl. 6, figs. 6 a, b)

Loxostomum applini NUTTALL (not PLUMMER), Journ. Pal., vol. 4, 1930, p. 285, pl. 24, figs. 4, 5.

Test long and slender, gradually tapering up to about the middle, latter half with the sides nearly parallel, the earliest portion slightly compressed and biserial, later becoming circular in transverse section and the latter half uniserial; chambers distinct, slightly inflated, the basal margin distinctly crenulate, later ones only slightly overlapping; sutures distinct, later ones slightly depressed; wall in the early biserial portion with fine, longitudinal costae, later uniserial portion smooth, distinctly perforate; aperture in the adult terminal, central, rounded, with a slight lip. Length 1.00 mm.; diameter 0.20-0.25 mm.

Holotype (Cushman Coll. No. 25458) from the Eocene, Kreyenhagen shale, Oil Canyon, 30 feet above upper sand, W. ¼ corner, Sec. 16-19-15, California.

Our material has been compared with that of Dr. Nuttall from the Eocene, Aragon formation, of Mexico, and the two lots of specimens are identical. It is not the same as *Loxostoma applini* Plummer from the Midway Eocene of Texas. It differs as noted by Nuttall in the larger number of uniserial chambers making up half of the test in the adult. The young stages resemble the Midway form from which it may possibly have been derived. It is in many respects very similar to the figure of *Bifarina adelae* Liebus from the middle Eocene of Northern Dalmatia but our species has a larger number of uniserial chambers. This is one of the species that very definitely correlate this lower part of the Kreyenhagen with the Aragon formation of Mexico.

UVIGERINA GARZAENSIS Cushman and Siegfus, n. sp. (Pl. 6, figs. 15 a, b)

Test fusiform, one and one-half to two times as long as broad, initial end rounded or subacute, apertural end tapering to an

elongate, very slender neck; chambers somewhat inflated, fairly distinct in the later portion but less so in the early portion, much overlapping except near the apertural end, somewhat flattened or concave on the inner face; sutures fairly distinct, not much depressed except in the later portion; wall finely hispid throughout; aperture with an elongate, very slender neck with a distinct but only slightly developed lip. Length 0.45-0.55 mm.; diameter 0.23-0.27 mm.

Holotype (Cushman Coll. No. 25459) from the Eocene, Kreyenhagen shale, from Garza Creek, King's Co., California. Siegfus locality 170.

This species most closely resembles *U. elongata* Cole from the Eocene, Guayabal formation of Mexico but differs in the larger size, less elongate form, more closely set chambers, the more slender, elongate neck, and the smoother surface.

UVIGERINA CHURCHI Cushman and Siegfus, n. sp. (Pl. 6, figs. 16 a, b)

Test about twice as long as broad, fusiform, the initial end rounded, apertural end also mostly rounded; chambers and sutures largely obscured by the surface ornamentation, last whorl of chambers slightly inflated and more distinct; wall ornamented by rather high longitudinal costae not continuous over adjacent chambers and often somewhat irregular and broken on the individual chamber; aperture large, with a very short, stout neck and very slightly developed lip. Length 0.55-0.70 mm.; diameter 0.30-0.35 mm.

Holotype (Cushman Coll. No. 25461) from the Eocene, Kreyenhagen shale, from Garza Creek, King's Co., California. Siegfus locality 170.

This species differs from *U. rippensis* Cole in the larger size, less conspicuous chambers and more broken costae. The species is named in honor of Mr. C. C. Church to whom we are indebted for release of some of this material for our study.

PLEUROSTOMELLA NUTTALLI Cushman and Siegfus, n. sp. (Pl. 6, figs. 17, 18)

Test elongate, slender, four or five times as long as broad, very slightly tapering, sides in the adult nearly parallel; chambers comparatively few, increasing rapidly in size and length as added, the last two making up more than half the surface of the test, alternating, but the later ones tending to become uniserial; sutures distinct, only slightly depressed, oblique; wall smooth

throughout; aperture with a distinct overhanging arch. Length 0.70-0.80 mm.; diameter 0.12-0.16 mm.

Holotype (Cushman Coll. No. 25466) from Kreyenhagen shale of Little Tar Canyon.

This is very similar to some of the specimens from the Eocene, Aragon formation, of Mexico referred by Nuttall to *P. alternans* Schwager a name which has been widely used for many different forms from Recent to Eocene and even in the Cretaceous. Our species differs from *P. alternans* in the less tapering form, fewer chambers, more remote arrangement of the chambers in the adult and the aperture in the median line. It is named in honor of Dr. W. L. F. Nuttall who has done much to make known the Eocene foraminifera of Mexico and other regions.

NODOSARELLA ADVENA Cushman and Siegfus, n. sp. (Pl. 6, figs. 19, 20)

Test elongate, straight or slightly curved, the earliest portion showing traces of a biserial condition in the obliquity of the sutures, circular in transverse section throughout; chambers distinct, inflated, four or five in number, increasing in relative height as added; sutures distinct, somewhat depressed, the early ones slightly oblique; wall smooth; aperture terminal, elongate, narrow, slightly curved, with a distinct lip, raised more on one side than on the other. Length up to 1.00 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 25468) from the Eocene, Kreyenhagen shale, of Little Tar Canyon, California. (U. S. G. S. Loc. 14437.)

This species is close to the form recorded by Cole from the Eocene of Mexico as "*Ellipsonodosaria rotundata* (d'Orbigny)" but is not the same as that of d'Orbigny from the Miocene of the Vienna Basin. Our species does not taper appreciably, has somewhat oblique sutures and the chambers do not enlarge as rapidly nor are they so inflated.

NODOSARELLA IGNOTA Cushman and Siegfus, n. sp. (Pl. 6, fig. 21)

Test elongate, tapering from the subacute initial end to the broadly rounded apertural end, circular in transverse section; chambers of the later portion distinct and subspherical, only slightly overlapping, earlier ones somewhat indistinct, more overlapping and less inflated, showing traces of a biserial condition; sutures indistinct in the earlier part, later distinct and somewhat depressed; wall ornamented by very fine longitudinal costae,

dividing dichotomously as the surface area of the test increases; aperture terminal, small, elongate, with a raised lip at one side. Length 0.70 mm.; diameter 0.25 mm.

Holotype (Cushman Coll. No. 25470) from the Eocene, Kreyenhagen shale, Little Tar Canyon, California. (U. S. G. S. Loc. 14437.)

VALVULINERIA ADVENA Cushman and Siegfus, n. sp. (Pl. 6, figs. 22 a-c)

Test trochoid, unequally biconvex, dorsal side less convex than the ventral, somewhat compressed, periphery rounded; chambers few, four in the adult whorl, of uniform shape, enlarging rapidly in size as added, the last-formed one making up nearly half the surface of the test; sutures distinct, slightly depressed, very slightly curved and nearly tangential on the dorsal side, ventrally nearly radial; wall smooth, conspicuously perforate; aperture a fairly large opening over the depressed umbilical region on the ventral side with a narrow but distinct overhanging lip. Length 0.50 mm.; breadth 0.45 mm.; thickness 0.30 mm.

Holotype (Cushman Coll. No. 25480) from the Eocene, Kreyenhagen shale, of Little Tar Canyon, California. (U. S. G. S. Loc. 14437.)

This species differs from *V. texana* Cushman and Ellisor in the larger size, fewer chambers, and less developed lip over the aperture.

PULLENIA EOCENICA Cushman and Siegfus, n. sp. (Pl. 7, figs. 1 a, b)

Test broadly rounded, slightly if at all compressed, close coiled, not depressed at the umbilicus, periphery broadly rounded; chambers distinct, inflated, normally five in the adult coil, increasing slowly in size as added, apertural face low; sutures distinct, only slightly depressed; wall smooth; aperture low, at the base of the apertural face, running almost the entire width of the test. Diameter 0.40-0.50 mm.; thickness 0.35-0.45 mm.

Holotype (Cushman Coll. No. 25485) from Kreyenhagen shale, Garza Creek, King's Co., California.

This species differs from *P. bulloides* (d'Orbigny) in having normally five instead of four chambers, and the aperture extending to the limits of the chambers at the sides.

This is similar to the Eocene material from Hungary referred by Hantken to d'Orbigny's species.

HANTKENINA cf. DUMBLEI Weinzierl and Applin (Pl. 7, fig. 2)

Hantkenina dumblei WEINZIERL and APPLIN, Journ. Pal., vol. 3, 1929, p. 402, pl. 43, figs. 5 *a*, *b*.

Although the spines on the figured specimen are broken the angles of the chambers and their shape are very similar to the type of *H. dumblei*. Although specimens are rare the identity of this species would seem to indicate the close correlation between this part of the Kreyenhagen and the Claiborne of Texas and Mexico.

ANOMALINA GARZAENSIS Cushman and Siegfus, n. sp. (Pl. 7, fig. 3 a-c)

Test nearly planispiral in the adult, much compressed, somewhat depressed in the middle portion of both sides, periphery rounded to subacute; chambers numerous, twelve to fifteen in the adult whorl, of rather uniform shape, increasing very gradually in size as added, all visible from the dorsal side, ventral side slightly evolute; sutures distinct, slightly depressed, very slightly curved, earlier ones on the dorsal side tending to become limbate; wall distinctly perforate, smooth, except on the ventral side where the inner ends of the chambers are often slightly expanded and a definite boss appears in the umbilical region; aperture small, at the base of the last-formed chamber in the median line. Diameter 0.45-0.55 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 22362) from the Eocene, Kreyenhagen shale, of Garza Creek, California.

This species differs from *A. alazanensis* Nuttall in the less flattened ventral side, somewhat broader and shorter chambers, less limbate sutures, and different ornamentation on the ventral side.

ANOMALINA DORRI Cole, var. ARAGONENSIS Nuttall (Pl. 7, fig. 5)

Our specimens have been compared with the types of Nuttall's variety from the Eocene, Aragon, of Mexico and seem to be identical. They are present in the lower part of the Kreyenhagen as represented in the collections from Little Tar Canyon. This is a striking form with its very coarse perforations giving a strongly pitted appearance to the surface.

CIBICIDES VENEZUELANUS Nuttall (Pl. 7, figs. 4 a-c)

Cibicides venezuelana NUTTALL, Journ. Pal., vol. 9, p. 131, pl. 15, figs. 25-27, 1935.

Nuttall described this species from the upper Eocene, Pauji shale, of Venezuela. The holotype of Nuttall's species has been

used for comparison with the material from Garza Creek and they seem identical. The ornamentation particularly of the ventral side is distinctive, somewhat resembling that of *Anomalina cocoaensis* Cushman from the Gulf Coastal upper Eocene of the United States but the dorsal side is very different. The measurements of our specimens also agree very closely with those of the Venezuelan species.

CIBICIDES CUSHMANI Nuttall (Pl. 7, figs. 7 a-c)

Cibicides cushmani NUTTALL, Journ. Pal., vol. 4, 1930, p. 291, pl. 25, figs. 3, 5, 6.

Our specimens show a considerable range of variation but a comparison with the types and paratypes shows a very similar range. Nuttall's types are from the Eocene, Aragon formation, Mexico.

CIBICIDES MARTINEZENSIS Cushman and Barksdale (Pl. 7, figs. 6 a-c)

Cibicides martinezensis CUSHMAN and BARKSDALE, Contrib. Dep't. Geol. Stanford Univ., vol. 1, 1930, p. 68, pl. 12, figs. 9 *a-c*.

The figured specimen from Garza Creek is very close to that described from the Eocene, Martinez formation, of California. It has been compared with the paratypes.

207. NOTES ON THE EARLY DESCRIBED MIOCENE SPECIES OF UVIGERINA

By JOSEPH A. CUSHMAN and PATRICIA G. EDWARDS

Before a satisfactory study of the American Miocene species of *Uvigerina* can be made, it is necessary to place definitely the numerous species described before 1914 from Europe and elsewhere. We have endeavored to determine as far as possible the characters of these species described by d'Orbigny, Karrer, Czjzek and others, either from the actual types, or from topotype material. The species will be taken up in chronological order.

UVIGERINA TRILOBATA d'Orbigny

Uvigerina trilobata D'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 269.—FORNASINI, Mem. Accad. Sci. Bologna, ser. 6 *a*, vol. 5, 1908, p. 43, pl. 1, fig. 11.

In 1826, d'Orbigny did not figure nor describe this species to which he gave a name, but indicated that it probably came from the Miocene "fossile aux environs de Bordeaux." In 1908, Fornasini gave figures in the above reference from the "planches inédites" showing a somewhat broadly fusiform test with distinct perforations or possibly a very finely hispid surface. We have examined a number of lots of material which we have from the Bordeaux region, but without finding any specimens which correspond to these figures. This species therefore must be left in an indefinite status. d'Orbigny described three new species in the Vienna Basin monograph in 1846: *Uvigerina urnula*, *U. semiornata*, and *U. aculeata*, and also refers some of his material to *U. pygmaea* d'Orbigny, which was originally described from the Pliocene of the Siena region and found living in the Adriatic.

UVIGERINA URNULA d'Orbigny (Pl. 8, figs. 19-26)

Uvigerina urnula D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 189, pl. 11, figs. 21, 22.

The types of this species are from Baden in the Vienna Basin. The occurrence is given as "Non frequens." One of the prominent features in each of the Latin, French and German descriptions is that the test is typically smooth, except on the earliest chambers where there are traces of costae. Such forms are figured on our plate, and are topotypes. There is, however, considerable variation between this species and the following. There are but few references to this species since its original description, and the only additional figures that seem to have been given for it are those of Toutkowsky which are evidently not the same.

UVIGERINA SEMIORNATA d'Orbigny (Pl. 8, figs. 8-14)

Uvigerina semiornata D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 189, pl. 11, figs. 23, 24.

The types of this species are from Nussdorf in the Vienna Basin where it is noted as rare. In d'Orbigny's description of this species, it is at once apparent that there were no great differences between it and the preceding one, *U. semiornata* being described as having weak longitudinal costae in the early part,

and being smooth in the later part. The size given for the two is practically the same. From a study of rather abundant material, it would seem that there are but few and very slight differences between the two. *U. semiornata* has somewhat stronger and more persistent costae than *U. urnula*. In our series it has been very difficult to draw any distinct line between them, and it would seem from the variations that there is no more than a varietal difference at most between the two. *U. semiornata* has been referred to but a few times in the literature, and it seems from the figures given rather questionable if any of them are the same as the Vienna Basin species.

From our study of abundant material of both of these forms, it would seem that this second one should be referred to as *U. urnula* d'Orbigny, var. *semiornata* d'Orbigny. Some of the specimens tend toward the form described by d'Orbigny in the Vienna Basin monograph as *U. pygmaea* d'Orbigny which is not the same as that described in 1826 as noted above.

UVIGERINA ACULEATA d'Orbigny (Pl. 8, figs. 1-5)

Uvigerina aculeata D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 191, pl. 11, figs. 27, 28.

The original figure does not show the apertural end completely, but it is evident that the species is ornamented in the early portion with distinct costae, while the adult chambers have distinct, spinose projections arranged more or less in longitudinal lines. The types are from Nussdorf where it is noted as "Non frequens." Our material shows a very considerable range in the variation of the surface characters. Some of the specimens closely resemble the type figure of d'Orbigny with a large portion of the surface covered by a spinose ornamentation. In others, particularly the microspheric forms, the costae typical of the early portion are continued in some specimens almost throughout, although in the later portion they tend to break up into spines. This species has been rarely recorded as a fossil, but there are numerous records in the literature for it as a Recent species, based largely upon the figures given by Brady in the *Challenger* Report. It is very evident from a study of the figures and of Recent material that the Recent form is not identical with the Miocene one of the Vienna Basin.

UVIGERINA ASPERULA Czjzek

Uvigerina asperula CZJZEK, in Haidinger's Nat. Abhandl., vol. 2, 1848, p. 146, pl. 13, figs. 14, 15.

As near as can be determined from the material available, this species has many of the characteristics of *U. aculeata* d'Orbigny, and probably represents one of the variations in which the costae persist, although being broken up into fine spines. It is evident that in the lithographic process by which Czjzek's plates were made, or else in the original drawings, the figures were much conventionalized as we have found no specimens in our material that were as finely spinose as shown in his figures, either of this or the following species. It is to be suspected that both of these species of Czjzek may be placed as variations of *Uvigerina aculeata* d'Orbigny.

Uvigerina asperula has been widely referred to as a Recent species, largely based on the figures given by Brady in the *Challenger* Report. It is very evident however from a study of the material from Baden that the Recent form is not identical with that of the Vienna Basin. The Recent form has the spinose ornamentation of the later portion as a distinct, secondary growth unlike that of Czjzek's species.

UVIGERINA ORBIGNYANA Czjzek

Uvigerina orbignyana CZJZEK, in Haidinger's Nat. Abhandl., vol. 2, 1848, p. 147, pl. 13, figs. 16, 17.

As already noted under the preceding species, this probably represents a variant of *Uvigerina aculeata* d'Orbigny, and may possibly be included as a synonym of that species. The types of both species are from Baden in the Vienna Basin.

UVIGERINA COCHLEARIS Karrer

Uvigerina cochlearis KARRER, Abhandl. k. k. geol. Reichsanst., vol. 9, 1877, p. 385, pl. XVI *b*, fig. 48.

The holotype of this species from Mödling was studied in the Museum at Vienna. It appears to be abnormal, and there are no others in the collection. It shows the very irregular form, and in the holotype figure has the costae most prominent at the base, and thence gradually becoming obsolete. It is from the Miocene of the Vienna Basin, and is probably a synonym of *Uvigerina urnula* d'Orbigny, var. *semiornata* d'Orbigny, as the costae are continued nearly to the upper end of the test.

UVIGERINA BRUNNENSIS Karrer

Uvigerina brunnensis KARRER, Abhandl. k. k. geol. Reichsanst., vol. 9, 1877, p. 385, pl. XVI *b*, fig. 49.

Fortunately it has been possible to study original material named by Karrer from Perchtoldsdorf. The specimens seem identical in every way with *Uvigerina urnula* d'Orbigny, var. *semiornata* d'Orbigny. In these specimens the perforations in certain lights give the appearance of a granulated surface as mentioned by Karrer, but the same is true of specimens of this variety from other localities in the Vienna Basin.

UVIGERINA PARKERI Karrer (Pl. 8, figs. 6, 7)

Uvigerina parkeri KARRER, Abhandl. k. k. geol. Reichsanst., vol. 9, 1877, p. 385, pl. XVI *b*, fig. 50.

The types of this species were studied in the Museum at Vienna. They are from Wöllersdorf. Our figures show two specimens identified by Karrer. The species is compressed, and in the later portion biserial. The surface in the earlier portion has numerous fine, longitudinal costae, and the later chambers have slightly raised granules arranged in longitudinal lines. It is related to *U. compressa* Cushman also described from the Vienna Basin, but the surface of the latter is much more distinctly costate throughout, and the earlier chambers are spinose at the basal margin. Both species may belong to the genus *Hopkinsina*.

UVIGERINA GLOBOSA Karrer

Uvigerina globosa KARRER, in von Drache, Frag. Geol. Insel Luzon, 1878, p. 94, pl. V, fig. 20.

This species described from the Tertiary of Luzon of the Philippines may be from the Miocene, although it is difficult to determine the exact age of it. From the figure, it is a short, stout species with very numerous, fine, longitudinal costae except on the last chamber, which may be smooth. We have had no material of this species for comparison.

UVIGERINA ACULEATA Hosius (not d'Orbigny)

Uvigerina aculeata HOSIUS (not D'ORBIGNY), Verh. Nat. Hist. Ver. Pr. Rheinlande, vol. 50, 1893, p. 108, pl. 11, fig. 9.

Under this name, Hosius described a species from Central Europe which is not at all like that described by d'Orbigny under the same name. It is a longitudinally costate form, the costae at

the base of the early chambers ending in short spines somewhat similar to the conditions seen in *U. compressa* Cushman. It is possible that these may represent the same species, although Hosius' types have not been studied.

UVIGERINA VENUSTA Franzenau (Pl. 8, figs. 15-18)

Uvigerina venusta FRANZENAU, Gasnik Hrv. nar. druztva, vol. 7, pt. 6, 1894, pl. 6, figs. 60, 61.

Under this name, Franzenau figures two forms from the Miocene of Hungary. The first of these is triserial, and strongly resembles figures given by d'Orbigny in 1846 which he refers to *Uvigerina pygmaea* d'Orbigny. It has very distinct and well developed longitudinal costae. His second figure seems to be nearly biserial throughout, and probably belongs to *Hopkinsina*. On our plate 8, figures 15-18 are species from Kostej in the Banat region of Hungary which, while less regular in form than the type figure given by Franzenau of his *U. venusta*, may belong to that species. The shape is usually more fusiform however, and the whole test less regular. Franzenau's type figure, however, with others in his paper, seem to be somewhat conventionalized, and this may account for the difference.

UVIGERINA LAUBEANA Schubert

Uvigerina laubeana SCHUBERT, Sitz. Deutsch. Nat. Med. Ver. Böhmen "Lotos," No. 6, 1899, p. 11, pl. 5, figs. 1 *a-c*.

Under this name, Schubert figures a finely costate form from the Miocene of Karwin. From the figures it is not very different from some of the specimens figured on our plate 8, figures 15-18, but we have no topotype material for comparison. The sutures on the figured specimen which shows the surface, are evidently not all drawn in detail, but from the other two figures given it would seem that it is very similar, at least, to the material which we have figured.

UVIGERINA UHLIGI Schubert

Uvigerina uhligi SCHUBERT, Sitz. Deutsch. Nat. Med. Ver. Böhmen "Lotos," No. 6, 1899, p. 12, pl. 5, fig. 2.

The single figure given of this species which is also from the Miocene of Karwin seems probably to be a young specimen of a costate form, and in some respects similar to specimens we have referred to *Uvigerina urnula* d'Orbigny, var. *semiornata* d'Or-

bigny. The exact status of this must be uncertain until type specimens are studied.

UVIGERINA NEUDORFENSIS Toula

Uvigerina neudorfensis TOULA, Jahrb. k. k. geol. Reichs., vol. 64, 1914 (1915), pp. 641, 644, pl. 39, fig. 11.

Under this name, Toula figures a costate species from the Miocene of Hungary which in some of its characters resembles the figures which we have given on our plate 8, figures 15-18, but his types have not been studied. In the same paper, he referred several figured specimens, plate 39, figure 9, to *U. pygmaea* d'Orbigny. These have fewer chambers and have different apertural characters. In some respects, they appear like strongly costate forms of *U. urnula* d'Orbigny, var. *semiornata* d'Orbigny, and are not unlike the figures of *U. pygmaea* given by d'Orbigny in his 1846 monograph.

We have reviewed the known Miocene species described up to 1914. A number of them are necessarily placed very indefinitely due to the fact that the original figures are lacking in detail, or are apparently conventionalized. In those species where type specimens or topotype material has been available, it seems possible to rather definitely fix their positions. Three forms in d'Orbigny's 1846 paper stand out definitely—*Uvigerina urnula* d'Orbigny and its variety *semiornata* d'Orbigny, and *U. aculeata* d'Orbigny. Under *U. urnula*, var. *semiornata*, there should be placed as synonyms *U. cochlearis* and *U. brunnensis* of Karrer. Under *U. aculeata* d'Orbigny, it is probable that *U. asperula* and *U. orbignyana* of Czjzek should be placed as synonyms within the limits of variation as shown by our series of specimens. *Uvigerina parkeri* Karrer is evidently a distinct species, and is best placed in the genus *Hopkinsina*. *Uvigerina compressa* Cushman should also be placed in that genus.

A name for the costate form of the European Miocene is difficult to determine. As noted above, it is not the same as *U. pygmaea* d'Orbigny, described from the Pliocene of the Siena region. For a discussion of this matter, see these Contributions, vol. 6, pt. 3, 1930, pp. 62-63, pl. 9, figs. 14-20. The first name for such forms in the Miocene is *U. venusta* Franzenau, but his figures as noted are conventionalized, and topotype material will have to be studied to determine this. The same is true of the species figured by Schubert—*U. laubeana*, and that figured by

Toula, *U. neudorfensis*. While there are many names applied to the Miocene Uvigerinas up to 1914, it will be seen that many of these names are apparently synonyms, and that the number of species actually involved is rather small.

208. PALEOECOLOGY AS SHOWN BY THE FORAMINIFERA

By Joseph A. Cushman

The conditions under which animals or plants live has a very important bearing on the faunas or floras that may be developed in any particular place. Little has been done along this line with the foraminifera although these animals are abundant and it is known that they are very sensitive to environmental conditions.

Work under way on both the Atlantic and Pacific coasts should give very definite data as to the occurrence of different species of the foraminifera in regard to depth and temperature. Relative abundance will be used to determine the conditions most favorable to the maximum occurrence of each species. When this data

---

EXPLANATION OF PLATE 7

Figs.

1 *a, b*. *Pullenia eocenica* Cushman and Siegfus, n. sp. Holotype. × 70. *a*, side view; *b*, apertural view.

2. *Hantkenina* cf. *dumblei* Weinzierl and Applin. × 50.

3 *a–c*. *Anomalina garzaensis* Cushman and Siegfus, n. sp. × 75. Holotype. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

4 *a–c*. *Cibicides venezuelanus* Nuttall. × 75. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

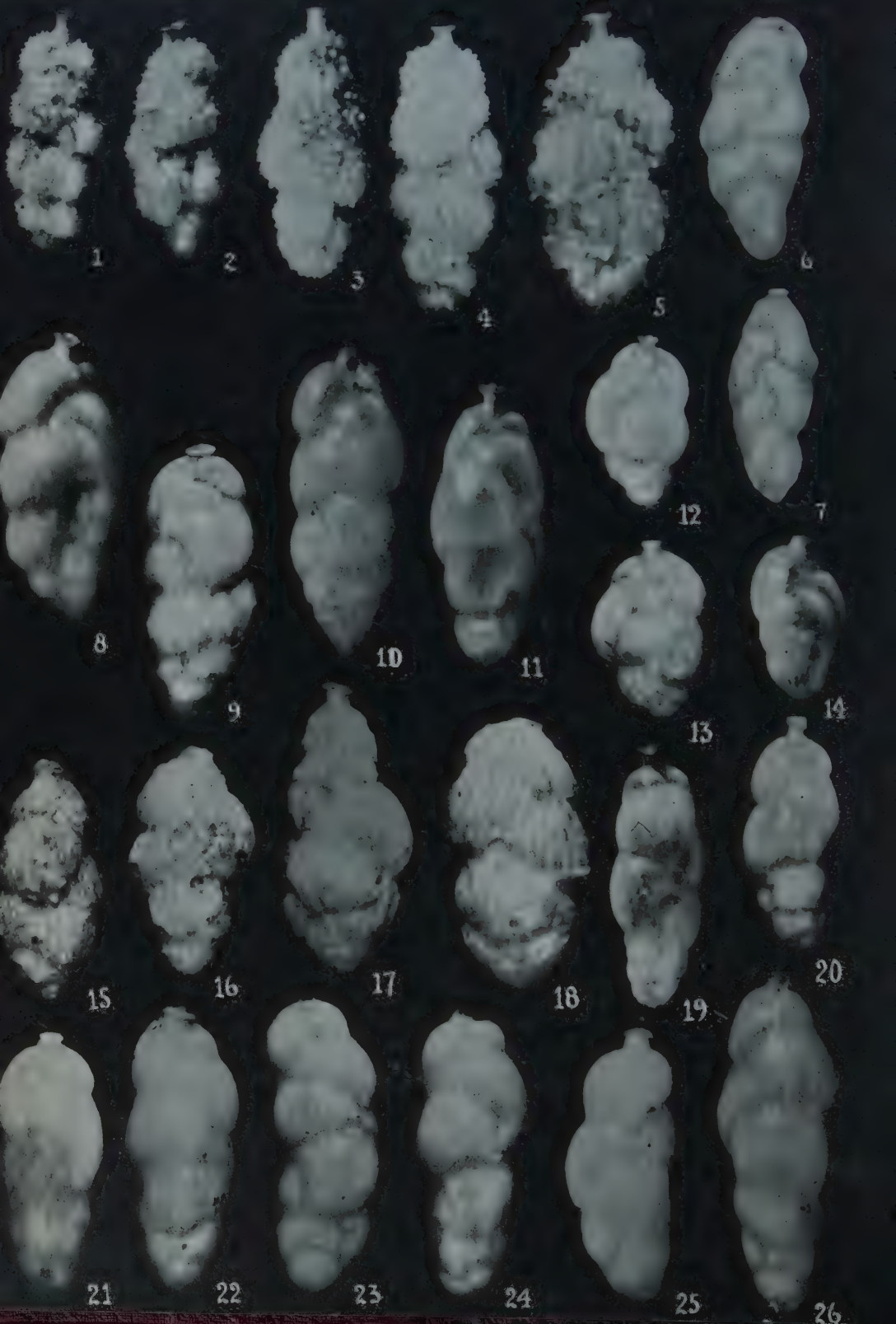
5. *Anomalina dorri* Cole, var. *aragonensis* Nuttall. × 50.

6 *a–c*. *Cibicides martinezensis* Cushman and Barksdale. × 75. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

7 *a–c*. *Cibicides cushmani* Nuttall × 90. *a*, dorsal view; *b*, ventral view. *c*, peripheral view.

From drawings and retouched photographs by Patricia G. Edwards.


1b
1a
2
3b
4b
5
3a
3c
4a
4c
6b
6a
7b
7c
7a
6c


1
2
3
4
5
6
8
9
10
11
12
7
13
14
15
16
17
18
19
20
21
22
23
24
25
26

is available it will be possible to give a rather accurate determination of the depth and temperature at which late Tertiary faunas related to these probably lived. Such data would give valuable information to stratigraphers and others interested in problems of correlation.

The sensitiveness of the foraminifera to environmental conditions may be illustrated by the writer's experience in collecting near Montego Bay, Jamaica, in 1912. Within sight of the laboratory there were four very distinct faunas. One of these was inshore from the coral reefs over which surf from the trade winds was constantly breaking. The bottom was of rather coarse coral sand and the fauna limited to the larger and heavier foraminifera. Outside the reefs was a bottom made up of finer coral sand but again in less than ten fathoms much disturbed. The fauna was richer than the first but still not abundant. To the west beyond a protecting point was very fine coral sand and mud which contained a very rich foraminiferal fauna very different from that off the reefs. In the shallower waters of this area grew great numbers of *Posidonia*, the short eel grass of the tropics. Several species grew attached to this eel grass and those forms such as *Planorbulina*, etc., often occurred in great numbers. A short distance further on are mangrove islands with shallow water and sticky muds which carried a meagre fauna much different from the other three. All four of these areas were relatively close together and yet their faunas had little in

---

EXPLANATION OF PLATE 8

FIGS.

1–5. *Uvigerina aculeata* d'Orbigny. 1, 2, 4, 5, × 50. 3, × 55. 1-4, From Perchtoldsdorf, Vienna Basin, Austria. 5, Topotype, from Baden, Vienna Basin, Austria.

6, 7. *Hopkinsina parkeri* (Karrer). × 68. Autotypes identified by Karrer from Möllersdorf, Vienna Basin, Austria.

8–14. *Uvigerina urnula* d'Orbigny, var. *semiornata* d'Orbigny. × 50. 13, Topotype from Nussdorf, Vienna Basin, Austria. 8-12, 14, From Baden, Vienna Basin, Austria.

15–18. *U. venusta* Franzenau(?) × 50. From Kostej, Banat region, Hungary.

19–26. *U. urnula* d'Orbigny. × 50. From Brünn, near Perchtoldsdorf, Vienna Basin, Austria.

All figures except 6, 7 from unretouched photographs.

common. If the areas were to be fossilized their faunas would be difficult to correlate unless one had a good knowledge of the ecologic conditions represented by them. These faunas were all living in depths of a very few fathoms at most and temperature and depth had little control in their distribution.

In order to determine the conditions under which various foraminiferal faunas lived it would be of much value if the relative abundance of the various species could be indicated with a reasonable degree of accuracy. This would allow an indication of the position of the shore line and other factors of interest. Faunal papers might be made of wider use if such relative abundance were accurately given.

Another factor which should be mentioned is the possibility of finding foraminifera at some distance from their actual place of life. For example, in tropical regions of the Pacific it has been found that species known to occur in less than thirty fathoms may occasionally occur as rare specimens at very much greater depths. An examination of these rare specimens usually shows that they are somewhat worn and were carried out by current and wave action after having been on beaches or in shallow water. Such occurrences in areas of rapidly changing depth should be carefully checked for possibility of transport to their present location. In a similar manner many instances are accumulating where fossil bearing beds outcropping along the lower parts of streams or on the seacoast are being eroded and their contents transported to considerable distances to mingle with living faunas. Recently bottom samples have been studied in this laboratory where the living fauna had with it specimens from Pliocene, Eocene and Cretaceous sources which were being eroded in the vicinity while the living fauna was being deposited. Each of the fossil horizons could be detected not only by the species but by the color and appearance of the specimens as well. This is an exceptional case but less complex examples are numerous.

In order to be of greatest value the basic data for occurrence of the foraminifera must be based on studies of living species. However, the data for interpreting fossil faunas must come through a study of relative abundance of genera and species as well as notes regarding the material in which they are found. This help can come from any worker who is studying any fossil foraminiferal fauna in full detail and who is willing to work out

the relative abundance of the elements of the fauna so that anyone working on the ecologic interpretation of these faunas may have the data available that he needs.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on foraminifera that have come to hand.

Thalmann, Hans E. Mitteilungen uber Foraminiferen IV. 16, Bemerkungen zur Frage des Vorkommens kretazischer Nummuliten. 17, Wert und Bedeutung morphogenetischer Untersuchungen an Gross-Foraminiferen fur die Stratigraphie. 18, Stratigraphische Verbreitung der Familien und Genera der Foraminiferen. 19, Foraminiferen-Statistik. —Eclogae geologicae Helvetiae, vol. 31, No. 2, 1938, pp. 327-344.—A new subgenus of *Operculina, Sulcoperculina,* with the subgenotype ?*Camerina dickersoni* Palmer, 1934.

Wicher, C. A. Mikrofaunen aus Jura und Kreide insbesondere Nordwestdeutschlands. 1. Teil: Lias *a-e.*—Preuss. Geol. Landes., Neue Folge, Heft 193, 1938, pp. 1-16, 27 pls., 4 text figs.—The plates mostly of foraminifera with a few ostracodes are from microphotographs.

Zeijlmans van Emmichoven, C. P. A. Korte Schets van de Geologie van Centraal-Borneo.—"De Ingenieur in Nederlandsch-Indie," IV. Mijnbovw en Geol., Jaargang V, No. 9, Sept., 1938, pp. 135-149, text fig., chart.—Mentions several genera of foraminifera.

Parr, W. J. Foraminifera of the Pliocene of South-Eastern Australia.—Mining and Geological Journal, vol. 1, No. 4, Jan., 1939, pp. 65-71, 1 pl. —Numerous species listed with notes on many of them, five new: *Pseudopolymorphina victoriensis, Glandulina kalimnensis, Siphonodosaria australis, Rotalia hamiltonensis,* and *Planulina kalimnensis.*

Mansfield, W. C. Note on unreported Oligocene in Citrus County, Florida. —Journ. Washington Acad. Sci., vol. 29, No. 2, Feb. 15, 1939, pp. 45, 46, text fig. 1.—Records *Lepidocyclina supera* (Conrad).

Bermudez, Pedro J. Resultados de la Primera Expedicion en las Antillas del Ketch Atlantis bajo los Auspicios de las Universidades de Harvard y Habana. Nuevo Género y Especies Nuevas de Foraminíferos.—Mem. Soc. Cubana Hist. Nat., vol. 13, 1939, pp. 9-12, pls. 1, 2.—*Barbourina,* n. gen.; *B. atlantica,* n. sp.; *Pullenia riveroi,* n. sp.

Foraminiferos del Género Recurvoides, descripción de una Especie Nueva. —L. c., vol. 13, 1939, pp. 57-62, pl. 5.—Describes and figures *Recurvoides obsoletus* (Goës), *R. turbinatus* (H. B. Brady), and *R. clenchi,* n. sp.

Tatum, E. P. Upper Cretaceous Chalk in Cap Rock of McFaddin Beach Salt Dome, Jefferson County, Texas.—Bull. Amer. Assoc. Petr. Geol., vol. 23, No. 3, March, 1939, pp. 339-342, 2 text figs.—Gives list of foraminifera.

Cole, W. Storrs. Large Foraminifera from Guam.—Journ. Pal., vol. 13, No. 2, March, 1939, pp. 183-189, pls. 23, 24, 1 text fig. (map.)—Miocene species figured and described with one new, *Spiroclypeus higginsi*, n. sp.

Ireland, Hubert A. Devonian and Silurian Foraminifera from Oklahoma.—L. c., pp. 190-202.—Numerous species figured and described, including twenty-one new species and three new varieties, with a new genus, *Bifurcammina* belonging to the Ammodiscidae.

Franke, Adolf. A simple apparatus for sorting microfossils.—L. c., pp. 225-227, 2 text figs.—Describes method for sorting foraminifera and other microfossils.

Howe, Henry V. Louisiana Cook Mountain Eocene Foraminifera.—State of Louisiana, Department of Conservation, Geol. Bull. 14, Jan., 1939, pp. 1-122, pls. 1-14, charts.—This work describes and figures eighty-four new species and varieties, and a new genus, *Tritubulogenerina*.

J. A. C.